

CLAIMS

What is claimed is:

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1. A method for raising a spacecraft launched into a transfer orbit about the Earth from the transfer orbit to a geosynchronous orbit, comprising the steps of:
 launching a spacecraft having chemical and electric propulsion thrusters and a solar array;
 5 firing the chemical propulsion thrusters at apogees of intermediate orbits, starting from the transfer orbit initiated by the launch vehicle, to successively raise perigees of the orbit until the perigee clears the Van Allen radiation belts;
 firing the electric propulsion thrusters to raise the orbit of the spacecraft from the orbit achieved by the chemical propulsion thrusters firing step to near geosynchronous
 10 orbit while steering the thrust vector and solar array to maintain the sun's illumination on the solar array; and
 selectively firing the chemical and/or electric propulsion thrusters to achieve final geosynchronous orbit.
2. The method recited in Claim 1 wherein the thrust vector is substantially normal to the axis of the solar array and the sun is maintained substantially normal to the solar array.
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3. The method recited in Claim 1 wherein the thrust vector is not normal to the axis of the solar array and the thrust vector is steered to provide sufficient solar array power to perform maneuvers and minimize propellant usage and/or time to achieve final orbit.
4. The method recited in Claim 1 wherein the transfer orbit is a subsynchronous orbit.
5. The method recited in Claim 1 wherein the transfer orbit is a supersynchronous orbit.
6. The method recited in Claim 1 wherein a thruster firing profile for firing the thrusters is generated onboard the spacecraft.

8. The method recited in Claim 1 wherein a spacecraft steering profile is generated on the Earth that steers the thrust vector (ΔV) to maintain the illumination of the sun's rays substantially normal to solar array.

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11. The method recited in Claim 1 wherein the step of firing the electric propulsion thrusters to raise the orbit of the spacecraft is periodically revised to compensate for disturbances experienced by the spacecraft.

12. The method recited in Claim 1 wherein the step of firing the electric propulsion thrusters to raise the orbit of the spacecraft is completed prior to reaching a desired on-orbit location whereupon chemical propulsion thruster firings are used to guide the spacecraft to the final desired orbit position to compensate for disturbances

13. The method recited in Claim 1 wherein the step of firing the electric propulsion thrusters to raise the orbit of the spacecraft is completed upon reaching a desired on-orbit location and chemical propulsion thruster firings are interspersed with electric thruster operation to guide the spacecraft to the final desired orbit position to

14. The method recited in Claim 1 wherein the step of firing the electric propulsion thrusters to raise the orbit of the spacecraft includes operating the electric thrusters in a throttled-back mode to enable increased acceleration capability to cope with disturbances experienced by the spacecraft.

23. A system for raising a spacecraft launched into a transfer orbit about the Earth from the transfer orbit to a geosynchronous orbit, comprising:

a spacecraft comprising chemical and electric propulsion thrusters and a solar array;

5 a processor onboard the spacecraft for:

firing the chemical propulsion thrusters at apogees of intermediate orbits, starting from the transfer orbit initiated by the launch vehicle, to successively raise perigees of the orbit until the perigee clears the Van Allen radiation belts;

10 firing the electric propulsion thrusters to raise the orbit of the spacecraft from the orbit achieved by the chemical propulsion thrusters firing step to near geosynchronous orbit while steering the thrust vector and solar array to maintain the sun's illumination on the solar array; and

selectively firing the chemical and/or electric propulsion thrusters to achieve final geosynchronous orbit.

24. The system recited in Claim 23 wherein the spacecraft comprises a processor that generates a thruster firing profile for firing the thrusters that is generated onboard the spacecraft.

25. The system recited in Claim 24 wherein the processor generates a spacecraft steering profile onboard the spacecraft that steers a thrust vector (ΔV) to maintain the illumination of the sun's rays substantially normal to solar arrays of the spacecraft.

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A5) 26. The system recited in Claim 24 wherein the processor generates a spacecraft steering profile onboard the spacecraft that steers a thrust vector (ΔV) such that the thrust vector is not normal to the axis of the solar array and the thrust vector is steered to provide sufficient solar array power to perform maneuvers and minimize propellant usage and/or time to achieve final orbit.

27. The system recited in Claim 23 further comprising:

ground apparatus including a processor that determines a thruster firing profile for firing the thrusters and generates thruster firing commands that implement the thruster firing profile, and communication apparatus that uplinks commands to the spacecraft.

28. The system recited in Claim 27 wherein the processor in the ground apparatus determines a spacecraft steering profile for steering the thrust vector to maintain the illumination of the sun's rays substantially normal to solar array and generates spacecraft steering commands that implement the spacecraft steering profile, and wherein the communication apparatus uplinks spacecraft steering commands to the spacecraft.

- 5 ~~sub 29. The system recited in Claim 27 wherein the processor in the ground apparatus determines a spacecraft steering profile for steering the thrust vector produced by the thrusters such that the thrust vector is not normal to the axis of the solar array and generates spacecraft steering commands that implement the spacecraft steering profile wherein the thrust vector is steered to provide sufficient solar array power to perform maneuvers and minimize propellant usage and/or time to achieve final orbit, and wherein the communication apparatus uplinks spacecraft steering commands to the spacecraft.~~

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